CHIWIMBO GWENAMBIRA

MICHIGAN STATE UNIVERSITY

DEPARTMENT OF PLANT, SOIL AND MICROBIAL SCIENCES

SNAPP LAB

***Soil Sampling Protocols***

**Sampling locations**

|  |  |  |
| --- | --- | --- |
| District | EPA | Mother trial host farmer name |
| Machinga | Ntubwi | Agnes Tiyesi |
| Machinga | Nsanama | Harry Milanzi |
| Machinga | Nyambi | YakumalaYusufu |
| Mangochi | Ntiya | PatumaMdala |

**Treatments**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Trt** | **YEAR 1** | **YEAR 2** | **N from NP** | **Urea N** | **P2O5** | **P source** |
| 1 | Maize + 69 kg/ha N | **Maize + no residues** | **0** | **0** | **21** | **SSP** |
| 2 | Maize + 69 kg/ha N | **Maize + x2 residues (from plots 1 and 2)** | **0** | **0** | **21** | **SSP** |
| 3 | Maize + 69 kg/ha N | **Maize+ x1 residues** | **0** | **0** | **21** | **SSP** |
| 4 | Maize + 69 kg/ha N | **Maize + no residues+ 35 kg/ha N** | **23** | **12** | **21** | **NP** |
| 5 | Maize + 69 kg/ha N | **Maize + x2 residues (from plots 4 and 5) + 35 kg/ha N** | **23** | **12** | **21** | **NP** |
| 6 | Maize + 69 kg/ha N | **Maize+ x1 residues + 35 kg/ha N** | **23** | **12** | **21** | **NP** |
| 7 | Pigeonpea/Groundnut + 35 kg/ha N | **Maize + no residues+ 35 kg/ha N** | **23** | **12** | **21** | **NP** |
| 8 | Pigeonpea/Groundnut + 35 kg/ha N | **Maize + x2 residues (from plots 7 and 8) + 35 kg/ha N** | **23** | **12** | **21** | **NP** |
| 9 | Pigeonpea/Groundnut + 35 kg/ha N | **Maize+ x1 residues + 35 kg/ha N** | **23** | **12** | **21** | **NP** |

Fertilization

1. Apply 100 kg/ha NP fertilizer at planting for treatments 4-9. This supplies N and P as follows:

* 23 kg N/ha
* 21 kg P205/ha (9.25 kg P (remember the conversion P = P2O5 × 0.44)

1. For treatments 4-9, the outstanding 12 kg N is applied as urea at 6 weeks after planting
   * 100 kg/ha urea supplies 46 kg N, therefore add 12/46 x100 = 26 kg/ha urea
   * For 30 m2 plot, this is very small amount of urea (0.08 kg urea per plot)
2. Treatments 1-3 that do not have N get P through a straight P fertilizer. Apply single super phosphate (SSP) at 110 kg /ha for 21 kg P205 (SSP contains 19%P2O5)
3. Fertilizer calculations (please everyone be familiar with fertilizer calculations)

To get amount of fertilizer per plot, use this simple formula

Fertilizer per plot = [Plot area/10,0000] x fertilizer rate per ha

If plot area is 6 m x 5 m =30 m2,

then for (1) above, NP fertilizer per plot =(30/10000) x100 = 0.3 kg NP fertilizer

**Sampling timeline and soil depths**

|  |  |  |
| --- | --- | --- |
| Time | Notes | Soil Depth (cm) |
| June 2017 | Before residue incorporation | 0-20, 20-40, 40-60 |
| July 2017 | 30 days after incorporation | 0-20, 20-40, 40-60 |
| November 2017 | During early rains | 0-20, 20-40, 40-60, 60-80, 80-100 |
| December 2017 | Soon after planting | 0-20, 20-40, 40-60, 60-80, 80-100 |
| January 2018 | 30 days after planting | 0-20, 20-40, 40-60, 60-80, 80-100 |
| March 2018 | At flowering | 0-20, 20-40, 40-60 |
| May 2018 | At physiological maturity | 0-20, 20-40, 40-60 |

**A. DRY SOIL SAMPLING**

**Materials**

Buckets

Hoes

Machete

Latex gloves

A4 Envelopes

**Procedure**

1. Mark two soil sampling points on ridges, in a diagonal line on each plot for every treatment
2. Label three buckets for each soil layer (0-20, 20-40 and 40-60 cm)
3. At each sampling point, dig a rectangular pit up to the desired depth, using a hoe
4. On one side of the pit, using a machete, mark where the 0-20, 20-40 and 40-60 cm soil layers start and end
5. From the sides of the pit, using a machete, carefully slice out soil samples from one layer at a time
6. Put the soil samples from each layer in the respective labelled bucket for each soil depth
7. Repeat the process for the other two sampling points on the plot
8. Put all the three 0-20 cm depth samples from the three sampling points in one bucket and do the same for the other depths. Therefore, if sampling from 0-20 cm, 20-40 cm and 40-60 cm on a plot, there would be three buckets labelled 0-20 cm, 20-40 cm and 40-60 cm. Each bucket will have a composite sample from the same depth but from three sampling points
9. Thoroughly mix the soil in each bucket using hands (whilst wearing gloves) and remove any stones and vegetation in the sample
10. Pour about 1kg of the composite sample into a pre-labelled envelope that has the sample ID and other appropriate information (e.g sample ID, date, farmer name, treatment, soil depth)
11. Close the envelope, staple it and put it into a plastic bag and tie the plastic
12. Put the tied plastic bag into another plastic bag and insert another label in between the two plastics
13. At the lab, air dry the samples for 48 hours
14. Sieve the soils using a 2-mm sieve and store accordingly

**B. WET SOIL SAMPLING FOR INORGANIC N (IN-FIELD KCL EXTRACTION)**

Adapted from Kane et al. (2015)

**Materials**

Augers

Buckets

50 ml centrifuge tubes filled with 40 ml 2M KCl

9-cm filter paper

Plastic scintillation vials

Funnels

Portable balance

**Procedure**

1. Mark two soil sampling points on ridges, in a diagonal line on each plot for every treatment
2. Label five buckets for each soil layer (0-20, 20-40 and 40-60,)
3. At each sampling point, collect soil cores for one soil depth at a time using an auger
4. Composite the soil cores by depth in the field by putting all the three cores from each sampling point for each specific depth into the respective labelled bucket
5. From each composite sample, collect two soil samples, one for in-field inorganic N extraction and the other for gravimetric moisture content determination
6. Weigh 10 g of soil on the balance and add it to a pre-labelled centrifuge tube with 40 ml 2M KCl(*A second 10 g sample from the same composite sample should be weighed for gravimetric soil moisture determination), the tubes should be carefully capped and kept in trays, in a safe, clean space (such as a cooler box).*
7. *Take all samples to the Chancellor College lab within ~5 days.*
8. Laboratory procedures:
9. Shake centrifuge tubes (with the soil and 2M KCl) at a low speedfor one hour
10. Allowed centrifuge tubes to settle for 15 mins
11. Fold 9 cm diameter filter paper in quarters
12. Filter supernatant with funnels and pour into vials, being careful not to collect soil in the filtrate.
13. Freeze samples (or refrigerate if analysis will be done immediately) until inorganic N analysis using the microplate reader as before.

**C. Gravimetric soil moisture content protocol**

Adapted from the KBS LTER protocol

**Materials**

Labels

Tins/paper bags

Plastic spoons

Portable Balance

**Procedure**

1. Prepare labels and label tins with appropriate information about the sample (e.g sample ID, date, farmer name, treatment, soil depth).
2. Tare tin/paper bag on balance
3. Weigh approximately 10 g of wet soil into tared tins/paper bags in the field using a spoon
4. Record the exact weight of soil
5. After transporting the soil to the lab, oven dry soil at 105 degrees C for 48 hours or until constant weight
6. If using bags, weigh about 10 empty paper bags and place them in the oven with soil.
7. When drying is complete, remove bags from oven and allow to cool for 15 minutes.
8. If using tins, recap tins as they are removed from the oven.
9. Tare balance to zero, weigh all the individual paper bags and record the weights.
10. Weigh all the tins or bags with dry soil and record the weights
11. Weigh empty paper bags and record as bag tare weight.

**Calculations**

% soil moisture = ((wet soil wt) – (dry soil wt – bag wt.) / (dry soil wt. – tin/bag wt.)) \* 100 (KBS LTER, 2017)

**References**

1. Kane, D. A., Snapp, S. S., & Davis, A. S. (2015). Ridge Tillage Concentrates Potentially

Mineralizable Soil N, Facilitating Maize N Uptake. Soil Science Society of America

Journal, 79(1), 81-88.

2. Kellogg Biological Station, Long Term Ecological Research.(2017): <https://lter.kbs.msu.edu/protocols/24>